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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/663,949	09/16/2003	Roswell J. Ruka	2003P07614US	3856

7590 08/26/2005

Siemens Corporation
Intellectual Property Department
170 Wood Avenue South
Iselin, NJ 08830

EXAMINER

AUSTIN, MELISSA J

ART UNIT	PAPER NUMBER
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1745

DATE MAILED: 08/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/663,949

Applicant(s)

RUKA ET AL.

Examiner

Melissa Austin

Art Unit

1745

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 June 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) 19-22 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-18 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1-4, 12, and 15-17 are rejected under 35 U.S.C. 102(e) as being anticipated by Barker et al. (U.S. Pre-grant Publication No. 2003/0015431), as evidenced by Herman et al. (*Ceramic Films and Coatings*, ed. Wachtman and Haber). Barker teaches a thin film fuel cell with a nickel/yttria stabilized zirconia (YSZ) anode, YSZ electrolyte, and strontium-doped lanthanum manganate cathode and interconnects. The electrode and electrolyte may be fabricated by anything film processing technique. (Pg. 2 – Pg. 4). According to Herman, plasma spraying has been used since the mid-1950's to form very homogeneous ceramic and cermet coatings (Pg. 131,138).

3. Claims 1-4, 12, and 15-17 are rejected under 35 U.S.C. 102(e) as being anticipated by Ramanarayanan et al. (*High Temperature Ion Conducting Ceramics*). Ramanarayanan (Pg. 22-24) teaches a solid oxide fuel cell in which a YSZ electrolyte is formed on a lanthanum manganate cathode by plasma spraying. A Ni/YSZ anode is then formed over the electrolyte by the same deposition process

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barker et al. (U.S. Pre-grant Publication No. 2003/0015431) in view of Jensen (5,035,962). Barker teaches the elements of claim 4 as discussed in the previous 35 U.S.C. 102 rejection, incorporated herein. However, Barker fails to disclose the composition of the fuel electrode.

Jensen teaches a fuel electrode for an SOFC having a graded composition structure formed by successively depositing layers of nickel-yttria stabilized zirconia mixtures with different compositions (Col. 3, ll. 6-9). Tables 1 (Col. 9) gives the compositions of the layers on a volume basis. In order to convert the volume percentages to weight percentages, the following formula was used:

$$\text{Weight}\%_j = \frac{\text{Vol}\%_j (\text{Vol}_j + \text{Vol}_k) \rho_j}{[\text{Vol}\%_j (\text{Vol}_j + \text{Vol}_k) \rho_j] + \text{Vol}\%_k (\text{Vol}_j + \text{Vol}_k) \rho_k} = \frac{\text{Vol}\%_j \rho_j}{[\text{Vol}\%_j \rho_j + \text{Vol}\%_k \rho_k]}$$

The densities used were obtained from www.matweb.com for yttria stabilized zirconia and nickel. The following table lists the weight percents corresponding the volume percents of Jensen's Table 1.

	Volume percent ZrO ₂	Weight percent ZrO ₂	Volume percent Ni	Weight percent Ni
Layer	70-90	63-87	10-30	13-37

1				
Layer 2	40-60	33-53	40-60	47-67
Layer 3	10-30	7.6-24	70-90	76-92.3

As can be seen from the table Jensen teaches minimums of about 60% Ni and about 15% YSZ (claim 5) and about 70% Ni and about 20% YSZ (claim 6). Jensen also teaches maximums of about 85% Ni and about 50% YSZ (claim 7) and about 80% Ni and about 30% YSZ. The compositions of the individual layers of the multiple layer graded structure approximate a layer in which the composition is continuously graded from being high in zirconia at the electrolyte interface to being high in nickel at the external surface of the anode and meets the simultaneous requirements of adhesion of the yttria stabilized zirconia electrolyte and adequate electrode electrical conductivity.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used the fuel electrode compositions as taught by Jensen in the fuel cell as taught by Barker in order to meet the simultaneous requirements of adhesion of the yttria stabilized zirconia electrolyte and adequate electrode electrical conductivity.

6. Claims 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barker et al. (U.S. Pre-grant Publication No. 2003/0015431) in view of Clemmer et al. (*Processing and Properties of Porous Ni-YSZ Metal/Ceramic Composites*), as evidenced by INCO, Ltd. Barker teaches the elements of claim 4 as discussed in the above 35 U.S.C. 102 rejection, incorporated herein, but fails to teach that at least a portion of nickel in the fuel electrode is obtained from nickel graphite powder.

Clemmer teaches Ni/yttria-stabilized zirconia fuel cell anodes in which Ni-coated graphite particles (55% Ni content; obtained from INCO, Ltd.: Pg. 233) were used as a starting material. Generally, the anodes created from the Ni-coated graphite particles had a lower coefficient of thermal expansion and higher electrical conductivity for a given Ni loading compared to the anodes made of separate Ni and graphite particles. The hybrid structures had intermediate values of coefficient of thermal expansion and electrical conductivity. (Abstract)

Nickel coated graphite particles available from INCO contain either 60 or 75% (www.incosp.com).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used Ni-coated graphite particles, such as those available from INCO, as a starting material for Ni/yttria-stabilized zirconia fuel cell anodes as taught by Clemmer in the fuel cell as taught by Barker in order to achieve lower coefficient of thermal expansion and higher electrical conductivity for a given Ni loading.

7. Claims 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barker et al. (U.S. Pre-grant Publication No. 2003/0015431) in view of Ramanarayanan et al. (*High Temperature Ion Conducting Ceramics*). Barker teaches the elements of claim 1 as discussed in the previous 35 U.S.C. 102 rejection but fails to teach the percentage of yttria in the yttria-stabilized zirconia (YSZ) of the anode. Ramanarayanan teaches that the yttrium oxide dopant in the Ni/YSZ anode serves to stabilize the high temperature cubic phase in zirconia and also generates oxygen

Art Unit: 1745

vacancies through a defect reaction to create more of the ion conducting species. Nickel may be used as the anode, but the thermal expansion of nickel does not match with that of the electrolyte, YSZ, and nickel may sinter at fuel cell operating temperatures. By forming a skeleton of YSZ around the nickel to form a cermet, the electrode thermal expansion coefficient is brought closer to that of the electrolyte and thus provides for better adhesion. (Pg. 22-24). It has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. (MPEP 2144.02, II.; *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)) Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the percentage of yttria in the Ni/YSZ anode in order to minimize thermal stress by matching the anode and electrolyte thermal expansion coefficients and to provide better adhesion between the anode and electrolyte.

8. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Barker et al. (U.S. Pre-grant Publication No. 2003/0015431) in view of Cable et al. (5,589,285). Barker teaches the elements of claim 1 as discussed in the previous 35 U.S.C. 102 rejection, incorporated herein. However, the reference fails to teach the precursor layer between electrolyte and fuel electrode containing zirconia.

Cable teaches an SOFC with a cathode containing lanthanum manganate (Col. 7, l 66 – Col. 8, l 2), an electrolyte of yttria-stabilized zirconia (Col. 8, ll. 12-14), and an anode containing a nickel powder mixed with zirconia (Col. 10, ll. 18-20). Between the electrolyte and anode, an interfacial layer (applicant's precursor layer) containing sulfur tolerant material is disposed (Col. 3, ll. 1-3); the interfacial layer may contain Y-doped

Art Unit: 1745

ZrO₂ (Col. 10, ll. 1-4; applicant's zirconia). The thickness of the interfacial layer is generally 1-100 μm , preferably less than 50 μm (Col. 8, ll. 35-37). The interlayer serves to improve electrical contact between the electrolyte and anode and provides an environment in which the species can interact or react because the interlayer keeps sulfur from the fuel from poisoning the anode, particularly Ni/YSZ cermet anodes (Col. 8, ll. 19-34; Col. 6, ll. 55-63; Col. 18, ll. 23-29).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the Y-doped zirconia interlayer as taught by Cable between the anode and the electrolyte of the fuel cell as taught by Barker in order to improve electrical contact and provide an environment in which the species can interact or react.

9. Claims 5-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ramanarayanan et al. (*High Temperature Ion Conducting Ceramics*) in view of Jensen (5,035,962). Ramanarayanan teaches the elements of claim 4 as discussed in the previous 35 U.S.C. 102 rejection, incorporated herein. However, Barker fails to disclose the composition of the fuel electrode.

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$$\text{Weight}\%_j = \frac{\text{Vol}\%_j (\text{Vol}_j + \text{Vol}_k) \rho_j}{[\text{Vol}\%_j (\text{Vol}_j + \text{Vol}_k) \rho_j] + \text{Vol}\%_k (\text{Vol}_j + \text{Vol}_k) \rho_k} = \frac{\text{Vol}\%_j \rho_j}{[\text{Vol}\%_j \rho_j + \text{Vol}\%_k \rho_k]}$$

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Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used the fuel electrode compositions as taught by Jensen in the fuel cell as taught by Ramanarayanan in order to meet the simultaneous

Art Unit: 1745

requirements of adhesion of the yttria stabilized zirconia electrolyte and adequate electrode electrical conductivity.

10. Claims 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ramanarayanan et al. (*High Temperature Ion Conducting Ceramics*) in view of Clemmer et al. (*Processing and Properties of Porous Ni-YSZ Metal/Ceramic Composites*), as evidenced by INCO, Ltd. Ramanarayanan teaches the elements of claim 4 as discussed in the above 35 U.S.C. 102 rejection, incorporated herein, but fails to teach that at least a portion of nickel in the fuel electrode is obtained from nickel graphite powder.

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Nickel coated graphite particles available from INCO contain either 60 or 75% (www.incosp.com).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used Ni-coated graphite particles, such as those available from INCO, as a starting material for Ni/yttria-stabilized zirconia fuel cell anodes as taught by Clemmer in the fuel cell as taught by Ramanarayanan in order to

Art Unit: 1745

achieve lower coefficient of thermal expansion and higher electrical conductivity for a given Ni loading.

11. Claims 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ramanarayanan et al. (*High Temperature Ion Conducting Ceramics*). Ramanarayanan teaches that the yttrium oxide dopant in the Ni/YSZ anode serves to stabilize the high temperature cubic phase in zirconia and also generates oxygen vacancies through a defect reaction to create more of the ion conducting species. Nickel may be used as the anode, but the thermal expansion of nickel does not match with that of the electrolyte, YSZ, and nickel may sinter at fuel cell operating temperatures. By forming a skeleton of YSZ around the nickel to form a cermet, the electrode thermal expansion coefficient is brought closer to that of the electrolyte and thus provides for better adhesion. (Pg. 22-24). It has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. (MPEP 2144.02, II.; *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)) Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the percentage of yttria in the Ni/YSZ anode in order to minimize thermal stress by matching the anode and electrolyte thermal expansion coefficients and to provide better adhesion between the anode and electrolyte.

12. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ramanarayanan et al. (*High Temperature Ion Conducting Ceramics*) in view of Cable et al. (5,589,285). Barker teaches the elements of claim 1 as discussed in the previous 35

Art Unit: 1745

U.S.C. 102 rejection, incorporated herein. However, the reference fails to teach the precursor layer between electrolyte and fuel electrode containing zirconia.

Cable teaches an SOFC with a cathode containing lanthanum manganate (Col. 7, l 66 – Col. 8, l 2), an electrolyte of yttria-stabilized zirconia (Col. 8, ll. 12-14), and an anode containing a nickel powder mixed with zirconia (Col. 10, ll. 18-20). Between the electrolyte and anode, an interfacial layer (applicant's precursor layer) containing sulfur tolerant material is disposed (Col. 3, ll. 1-3); the interfacial layer may contain Y-doped ZrO_2 (Col. 10, ll. 1-4; applicant's zirconia). The thickness of the interfacial layer is generally 1-100 μm , preferably less than 50 μm (Col. 8, ll. 35-37). The interlayer serves to improve electrical contact between the electrolyte and anode and provides an environment in which the species can interact or react because the interlayer keeps sulfur from the fuel from poisoning the anode, particularly Ni/YSZ cermet anodes (Col. 8, ll. 19-34; Col. 6, ll. 55-63; Col. 18, ll. 23-29).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the Y-doped zirconia interlayer as taught by Cable between the anode and the electrolyte of the fuel cell as taught by Ramanarayanan in order to improve electrical contact and provide an environment in which the species can interact or react.

Conclusion

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Many published patents and applications teach an air electrode supported fuel cell of lanthanum manganate, an electrolyte or yttria stabilized zirconia, and an anode of nickel/zirconia formed on the electrolyte. Among them are such patents as 4,490,444 and 6,291,089.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Melissa Austin whose telephone number is (571) 272-1247. The examiner can normally be reached on Monday - Thursday, alt. Friday, 7:15 AM - 4:15 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

mja

Application/Control Number: 10/663,949

Page 13

Art Unit: 1745

Melissa Austin
Patent Examiner
Art Unit 1745


PATRICK JOSEPH RYAN
SUPERVISORY PATENT EXAMINER